

# MB40 & MB45 MODBUS TCP/IP Gateway Handbook

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## MB40 & MB45 MODBUS TCP/IP Gateway – DL30 type Envirodata Weather Stations

- Connects an Envirodata DL3000 Weather Station to a Modbus network
- Modbus RTU over RS485 and Modbus TCP/IP over Ethernet compatible
- Easy Modbus TCP/IP configuration via webpage, Modbus registers, or on-board switches
- Supports three simultaneous Modbus TCP masters.
- Retrieves current weather values, 10 minute values, hourly values, and daily values.
- Can be used to synchronise the date and time of the Weather Station directly



### Overview

The MB40 Modbus TCP DL3000 Gateway allows the easy connection of a PLC (Programmable Logic Controller), RTU (Remote Telemetry Unit) or SCADA System to a Weather Station. Using the Modbus RTU (Binary), or Modbus TCP/IP (Ethernet) protocols, it enables a programmable controller to monitor and carry out actions based on wind speed, wind direction, temperature and many other weather based variables.

The MB40 Modbus TCP DL3000 Gateway is a major upgrade to MB30 Serial DL3000 Gateway. It provides all the functionality of the MB30, with the following improvements:

- Addition of Ethernet:
- Allows the MB40 to be polled by up to three Modbus TCP/IP masters simultaneously
- Provides a webpage whereby TCP/IP settings can be easily monitored and altered. Also shows current communications statuses.
- Can be interrogated over HTTP to return Modbus register values in XML format
- Retrieves the current weather data, as well as the 10 minute, hourly, and daily weather data.
- Allows up to 125 registers to be polled at once – previously limited to 30.
- Provides a method to set up the date and time of the DL3000 Weather Station.
- Turns off “verbose mode” on the weather station.

MB40 is a standalone version that is suitable for DIN rail mounting, while MB45 is enclosed in the sealed housing of the weather recorder with access via a sealed gland.

## Please Note

Please note that Envirodata's software program, EasiAccess, will NOT connect to the MB40 / MB45. This is because EasiAccess does NOT use the MODBUS protocol.

EasiAccess can connect DIRECTLY to an Envirodata Weather Station via either a LAN (TCP/IP) address or a serial (COM) port. But in both cases, the communication is text commands, and NOT MODBUS commands.

MODBUSVIEW TCP is a program that can connect via either a LAN (TCP/IP) address or a serial (COM) port, and does use MODBUS commands. You can get a copy of this program either from the Envirodata EasiAccess distribution CD or download from the Internet at <https://oceancontrols.com.au/OCS-011.html>

As a free copy, MODBUSVIEW TCP will work for 15 minutes as a test program. Restarting the program will provide a further 15 minutes operation, as required.

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## Getting Started

### Configuring the MB40

*Table 1: Connections to the MB40*

Connection	Description
<b>V +</b>	Power Positive (8 to 28V DC)
<b>GND</b>	Power Negative (Ground)
<b>D +</b>	RS485 Data +
<b>D -</b>	RS485 Data -
<b>GND</b>	Ground
<b>Male D9</b>	Serial communications (RS232) between MB40 and Weather Station
<b>RJ45 Socket</b>	Ethernet Port

*Table 2: MB40 LED Functions*

LED	Function
<b>Red Tx LED (next to RS485 terminal)</b>	Indicates serial communications received on RS485
<b>Green Rx LED (next to RS485 terminal)</b>	Indicates serial communications sent (Modbus RTU) on RS485
<b>Green Rx LED next to D9 connector</b>	Indicates serial communications received (from weather station) on the serial port
<b>Red Tx LED next to D9 connector</b>	Indicates serial communications sent on the serial port
<b>Green LED (right side) on RJ45 socket</b>	Link LED. Always on to indicate good status for Ethernet, flashes to indicate activity.
<b>Yellow LED (left side) on RJ45 socket</b>	FDX LED. On = Full duplex Ethernet Off = Half duplex Ethernet
<b>Green Rx LED next to RJ45 socket</b>	Flashes when packets are received on the Ethernet port.
<b>Red Tx LED next to RJ45 socket</b>	Flashes when packets are sent on the Ethernet port.

## Configuring Modbus

### Modbus RTU

Serial Modbus is provided on RS485. The communications settings for this port are set 8 DIP switches next to the D9 connector. Any changes to the switches won't take effect until the MB40 is power cycled.

*Table 3: Modbus RTU address switches*

Modbus RTU Address	Switch 1	Switch 2	Switch 3	Switch 4
1	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF
3	OFF	ON	OFF	OFF
4	ON	ON	OFF	OFF
5	OFF	OFF	ON	OFF
6	ON	OFF	ON	OFF
7	OFF	ON	ON	OFF
8	ON	ON	ON	OFF
9	OFF	OFF	OFF	ON
10	ON	OFF	OFF	ON
11	OFF	ON	OFF	ON
12	ON	ON	OFF	ON
13	OFF	OFF	ON	ON
14	ON	OFF	ON	ON
15	OFF	ON	ON	ON
16	ON	ON	ON	ON

*Table 4: Modbus RTU Baud Rate switches*

Baud Rate	Switch 5	Switch 6
2400	OFF	OFF
4800	ON	OFF
9600	OFF	ON
19200	ON	ON

*Table 5: Modbus RTU Parity switches*

Parity	Switch 7	Switch 8
None	OFF	OFF
Even	ON	OFF
Odd	OFF	ON
Boot-loader <sup>1</sup>	ON	ON

<sup>1</sup> The boot-loader is an advanced function that allows firmware updates to be deployed in the field.

## Modbus TCP/IP & Ethernet Webserver

To communicate over a TCP/IP network, the MB40 needs five pieces of information:

1. The Internet Protocol (IP) address of the MB40 within the network. Set by the user
2. The Subnet Mask of the network. Set by the user
3. The Default Gateway of the network. Set by the user.
4. A unique MAC address. Shipped preloaded by Environdata.
5. The TCP/IP port the request is being sent on. For the MB40, Modbus TCP/IP is on port 502, and the webserver (HTTP) is on port 80.

These settings themselves can be set by one of three available methods:

1. The 8 DIP switches next to the D9 connector.
2. Modbus registers (using either Modbus RTU on RS485 or Modbus TCP/IP on Ethernet)
3. The webpage.

### Configuration Using Switches –Switch 1

Switch one determines where the TCP/IP settings are loaded from when power is applied to the MB40. With this switch off, settings are loaded from the current values of the switches, regardless of previous settings. With the switch on, the settings are loaded from internal memory - saved after being previously configured via the webpage or Modbus.

*Table 6: TCP/IP mode switch*

Power Up Configuration	Switch 1
OFF	TCP/IP settings from switches
ON	TCP/IP settings from internal persistent memory

### Configuration Using Switches –Switch 2

Switch two is the “panic switch”, returning the MB40 to default if the user writes incorrect values or doesn’t otherwise know what settings the card currently possesses. To use, flick the switch on, hold for one second, and turn back off again. **Don’t leave this switch on; the card will be constantly resetting and therefore unresponsive.**

#### Default Values

- IP Address: 192.168.1.100
- Subnet Mask: 255.255.255.0
- Default Gateway: 192.168.1.1

*Table 7: TCP/IP Reset Switch*

Reset to Default	Switch 2
OFF	No action
ON	TCP/IP settings reset to default

### Configuration Using Switches –Switch 3 & 4

Switches three and four choose between four different TCP/IP schemes commonly used in private address space:

*Table 8: TCP/IP Subnet switches*

TCP/IP Base Settings		Switch 3	Switch 4
IP Address:	192.168.1.x		
Subnet Mask:	255.255.255.0	OFF	OFF
Default Gateway:	192.168.1.1		
IP Address:	10.0.0.x		
Subnet Mask:	255.0.0.0	OFF	ON
Default Gateway:	10.0.0.1		
IP Address:	10.1.1.x		
Subnet Mask:	255.255.0.0	ON	OFF
Default Gateway:	10.1.1.1		
IP Address:	172.16.0.x		
Subnet Mask:	255.240.0.0	ON	ON
Default Gateway:	172.16.0.1		

### Configuration Using Switches –Switch 5 to 8

The final four switches determine the last octet of the IP address.

*Table 9: TCP/IP IP Address switches*

Last Octet (IP Address)	Switch 5	Switch 6	Switch 7	Switch 8
100	OFF	OFF	OFF	OFF
101	ON	OFF	OFF	OFF
102	OFF	ON	OFF	OFF
103	ON	ON	OFF	OFF
104	OFF	OFF	ON	OFF
105	ON	OFF	ON	OFF
106	OFF	ON	ON	OFF
107	ON	ON	ON	OFF
108	OFF	OFF	OFF	ON
109	ON	OFF	OFF	ON
110	OFF	ON	OFF	ON
111	ON	ON	OFF	ON
112	OFF	OFF	ON	ON
113	ON	OFF	ON	ON
114	OFF	ON	ON	ON
115	ON	ON	ON	ON

### Configuration Using Webpage

The MB40 has an inbuilt web server that can service HTTP requests on port 80. Simply point your web browser to the IP Address of the MB40 to retrieve this page.

Below the current communications statuses is a web form with provision to set the TCP/IP settings of the MB40. The form fields will be populated with the Gateway's current values. These can be altered and written to the MB40.

After writing these values, you will likely want to change TCP switch 1 to read from memory on the next power up, otherwise the TCP/IP configuration will read from the switches.

### Configuration Using Modbus (RTU or TCP/IP)

The MB40 has 13 Modbus holding registers reserved for configuration. These settings can be read and written using either serial Modbus (RTU on RS485) or Modbus TCP/IP.

*Table 10: Modbus TCP/IP Configuration Registers*

Modbus Register	Function
256	1st octet IP Address
257	2nd octet IP Address
258	3rd octet IP Address
259	4th octet IP Address
260	1st octet Subnet Mask
261	2nd octet Subnet Mask
262	3rd octet Subnet Mask
263	4th octet Subnet Mask
264	1st octet Default Gateway
265	2nd octet Default Gateway
266	3rd octet Default Gateway
267	4th octet Default Gateway
268	Commit to Gateway (write a 1)

Each register holds one octet of the TCP/IP configuration. These can be read to view the current TCP/IP settings, or written to set the values. Once all twelve octets are manually set, the settings are committed to the gateway by writing a one to holding register 268. Make sure **all** registers are written with correct values before they are committed to the gateway.

## Weather Station Data

The gateway operates as a Modbus slave. To access the holding registers in the gateway, the PLC or RTU must be configured as a Modbus Master. Using Modbus Function 3, the PLC can read the Holding Registers.

### Current Weather Data

*Table 11: R3 Modbus Register Listing*

Holding Register Address 40,000+	No. of Registers	Type	Description
1	1	Time	Year in format YYYY
2	1	Time	Month and day in format MMDD
3	1	Time	Hour in format HH
4	1	Time	Minute and second in format MMSS
5 to 59	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
60	1	Status	Comms status for the R3 command. 0 = bad, 1 = good.

### Daily Weather Data

*Table 12: MEM 1 LAST Modbus Register Listing*

Holding Register Address 40,000+	No. of Registers	Type	Description
61	1	Time	Year in format YYYY
62	1	Time	Month and day in format MMDD
63	1	Time	Hour in format HH
64	1	Time	Minute and second in format MMSS
65 to 119	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
120	1	Status	Comms status for the MEM 1 LAST command. 0 = bad, 1 = good.

### Last Hourly Data

*Table 13: MEM 2 LAST Modbus Register Listing*

Holding Register Address 40,000+	No. of Registers	Type	Description
121	1	Time	Year in format YYYY
122	1	Time	Month and day in format MMDD
123	1	Time	Hour in format HH
124	1	Time	Minute and second in format MMSS
125 to 179	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
180	1	Status	Comms status for the MEM 2 LAST command. 0 = bad, 1 = good.

## Last 10-Minute Data

**Table 14: MEM 3 LAST Modbus Register Listing**

Holding Register Address 40,000+	No. of Registers	Type	Description
181	1	Time	Year in format YYYY
182	1	Time	Month and day in format MMDD
183	1	Time	Hour in format HH
184	1	Time	Minute and second in format MMSS
185 to 239	1	Data	Unpacked weather data. Up to 54 "pieces" of comma separated data is sequentially unpacked and placed into holding registers.
240	1	Status	Comms status for the MEM 3 LAST command. 0 = bad, 1 = good.

### Weather Station Data Notes:

1. *The gateway decodes comma separated values. Once the date code has been deciphered, the remaining data is chopped into individual numbers, treating the comma as a separator. Each number is converted and packed into the next available holding register, up to a limit of 54 numbers.*
2. *Weather Station data is internally limited to  $\pm 32760$ . Values beyond this range are capped to an error code shown below.*
3. *The decimal point is ignored in all cases. This could cause overflow on semantically in range numbers such as 12345.67, and also 10000.00.*
4. *Numbers larger than 32760 are displayed as the error value: 32761*
5. *Numbers smaller than -32760 are displayed as the error value: 32762*
6. *Weather station +OVERFLOW values are displayed as error code: 32763*
7. *Any other conversion failure is displayed as: 32764*
8. *No arithmetic is done using floating point numbers. There is therefore no underflow error.*

## Functionality

### Weather Station Polling Period

By default, the gateway asks for each data packet from the weather station every 2.5 seconds. The polling period can be changed by writing to Modbus register 247. Enter your preferred polling period as a number in tenths of seconds (i.e for 2.5 seconds enter 25).

## Weather Station Date and Time Configuration

The date and time of the weather station can be directly altered by the MB40, by writing to specific Modbus Registers. The date command is of the following format:

**SET DATE YYYY MM DD<cr>**

Where each argument is set using the Modbus registers:

**SET DATE holding\_register[248] holding\_register[249] holding\_register[250] <cr>**

The command is sent to the Weather Station by writing a 1 to Holding Register 251.

Similarly, the time command is of the following format:

**SET TIME HH MM SS<cr>**

Where each argument is set using the Modbus registers:

**SET TIME holding\_register[252] holding\_register[253] holding\_register[254] <cr>**

The command is sent to the Weather Station by writing a 1 to Holding Register 255.

Note that there is no error checking on this interface. Once a one is written to the send register, the command will be sent to the weather station, even if there is garbage or incorrect arguments specified. **Take care when using this functionality.**

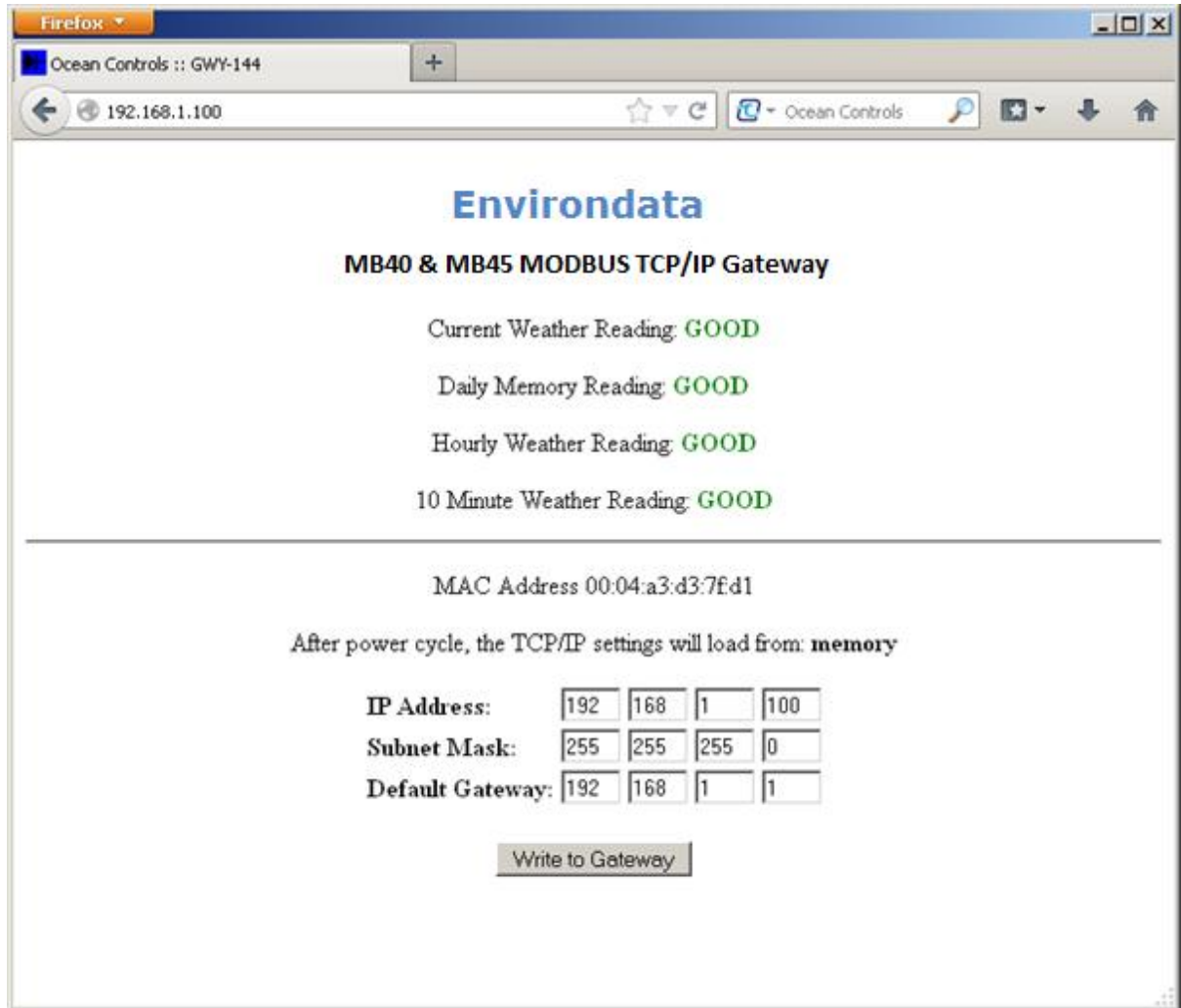
*Table 15: EEPROM Write Modbus Register Listing*

Modbus Holding Register		Description
248	Year argument	Four digits: format YYYY
249	Month argument	Two digits: format MM. Padded with leading zeroes.
250	Day argument	Two digits: format DD. Padded with leading zeroes.
251	Commit Date to Weather Station	Write a 1 to send date command.
252	Hour argument	Two digits: format HH. Padded with leading zeroes.
253	Minute argument	Two digits: format MM. Padded with leading zeroes.
254	Second argument	Two digits: format SS. Padded with leading zeroes.
255	Commit Time to Weather Station	Write a 1 to send time command.

## Webpage

In addition to providing an interface to read and write the TCP/IP configuration values, the webpage also provides the user with a view of the current status of the MB40

Figure 1: MB40 Webpage



The webpage gives an indication of the current communication status between the gateway and weather station, either “GOOD” or “BAD” for each data packet.

Directly above the horizontal line reads the MAC address for the MB40. This identifier is globally unique.

Directly below the horizontal line are the configuration fields for the gateway, and a line of text reading: “After power cycle, the TCP/IP settings will load from: <dynamic value>”. This text will read either “switches” or “memory” based on the status of TCP switch 1. It is important to realise that the TCP/IP settings may still be read from the switches on power up, despite changing them using Modbus or the webpage.

## XML Request

In addition to Modbus TCP/IP, the gateway can also return the status of the holding registers via an XML file over HTTP (port 80). To trigger this request; send a HTTP GET query to the MB40's IP Address with the register number appended after a forward slash. Alternatively, the entire register listing can be returned by using the same query with a "registers.xml" termination. The XML file structure is shown in the screenshots. This format is consistent.

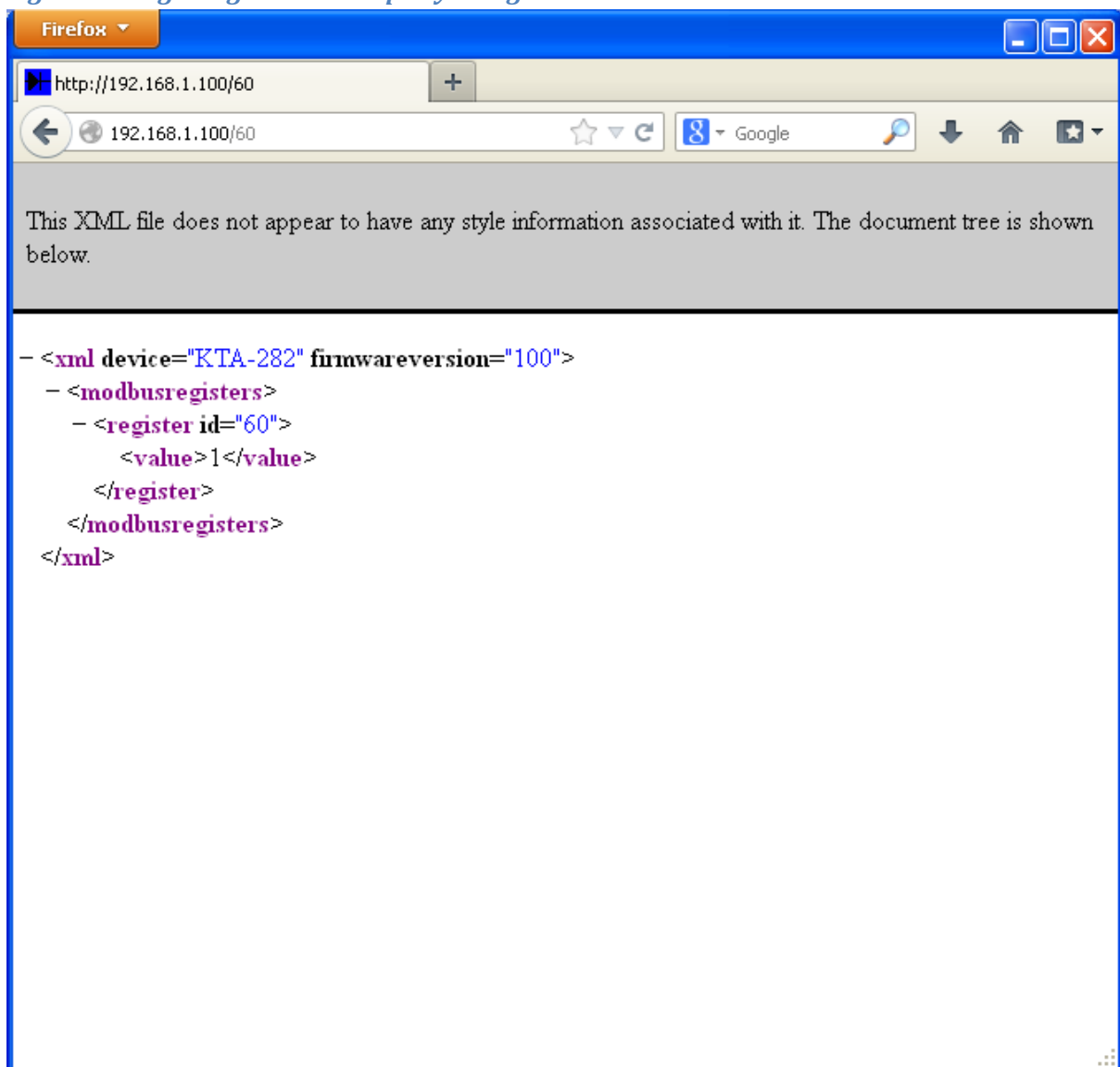
### Single Register

<IP Address> / <holding register number>

Using a web browser - with the gateway at its default address – requesting register 60:

**192.168.1.100/60**

*Figure 2: Single register HTTP query using browser*



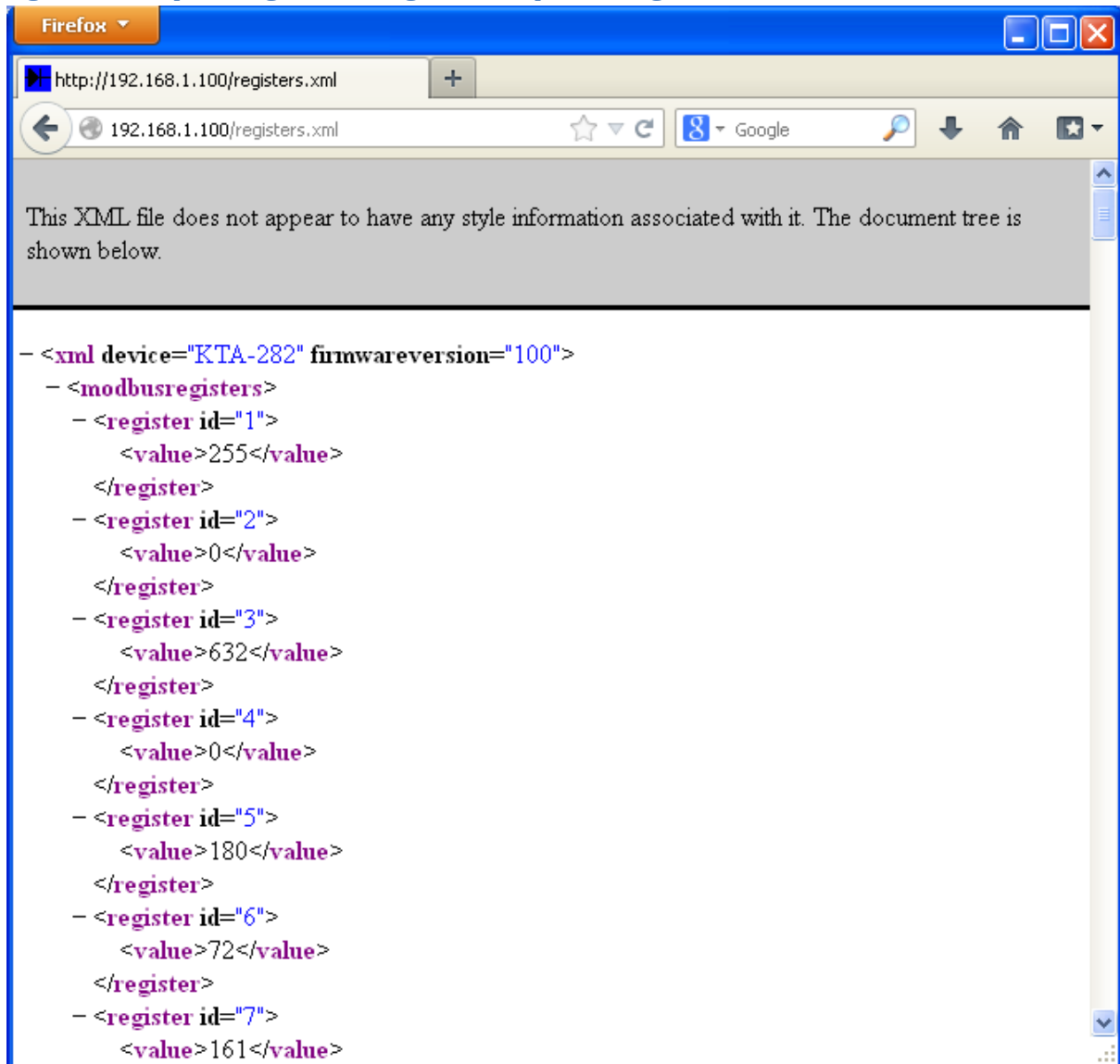
## All Registers

<IP Address>/registers.xml

Using a web browser – with the gateway at its default address:

192.168.1.100/registers.xml

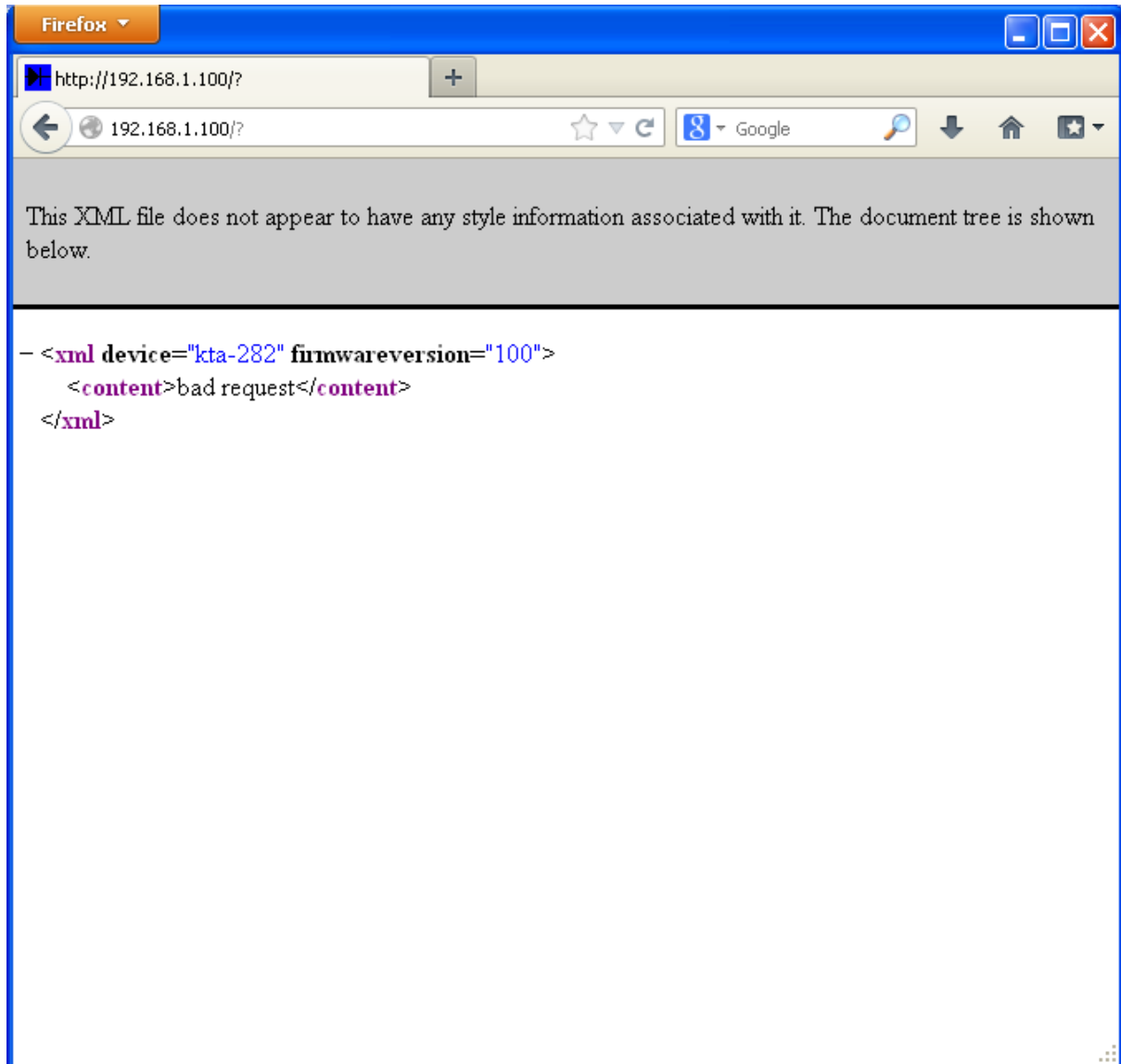
*Figure 3: Complete register listing HTTP request using browser*



## Error Request

If the GET request is of the wrong format or otherwise unrecognised by the MB40, a bad request XML is returned.

*Figure 5: "Bad Request" XML file*



## Troubleshooting

A number of LED's have been provided to assist with troubleshooting, should you run into problems with the MB40.

### Power Connected

Without any connections made except power, the Tx LED next to the D9 port should flash red once roughly every 5 seconds. This confirms the gateway is on and operational.

### Weather station Comms

If the Gateway is receiving messages from the weather station, the green Rx LED should flash in response to the red Tx LED roughly every 10 seconds.

### Ethernet

If a valid connection is made on Ethernet cable between another controller, network card, or Ethernet switch, at least one LED on the Ethernet socket will be illuminated – regardless of TCP/IP settings. If not, there is a problem with the network equipment.

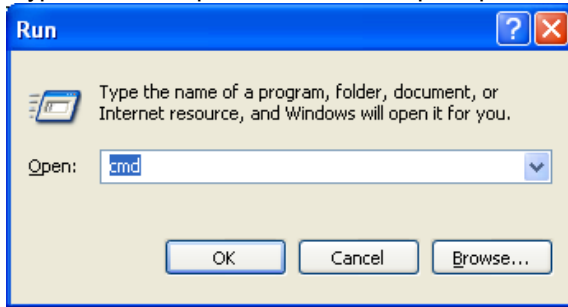
### RS485

If any type of serial data is sent over RS485, the Rx LED will flash. If the serial data is a valid Modbus command at the correct address, baudrate, and parity, the gateway will send a response. This will cause the green Tx LED to flash.

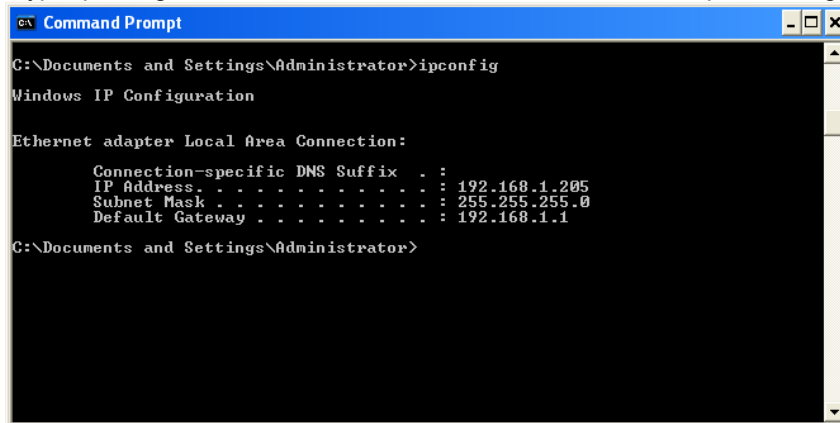
## Troubleshooting Procedure

- 1) Begin with the Gateway disconnected from all cabling and all DIP switches in the off position.
- 2) Apply 8 to 28 volts to the power terminals. Check the Tx LED next to the D9 port. It should flash red roughly once every 5 seconds. If so, move to step 3. If not:
  - a) Check the wires of the power supply are the correct way around.
  - b) Probe the power terminals with a multimeter to ensure you are receiving the required DC voltage.
- 3) Plug the weather station into the MB40 using the D9 connector. Check the Rx LED next to the D9 connector. It should now flash green in combination with the red LED. If so, move to step 4. If not:
  - a) Check that the weather station is powered.
  - b) Check the cabling from the weather station to the gateway.
  - c) Plug an Ethernet cable from the gateway to a controller (either directly or via an Ethernet switch). After a moment, the lights on the Ethernet socket should illuminate/flash. If so, go to step 4. If not, there is a problem with the network hardware. Try:
    - i) Making a direct connection between the MB40 and a PC.
- 4) Use the switches to set the TCP/IP settings. Using a machine in the same subnet, browse to the IP address of the gateway. If you see the MB40 webpage, you have successful Ethernet communications. The gateway can be polled by a Modbus TCP/IP master on this address. If not:
  - a) Check your network settings to make sure the gateway is in the same subnet as your other network hardware. On windows:
    - i) Press: windows + R to open the run dialogue box.

- ii) Type "cmd" to open the command prompt



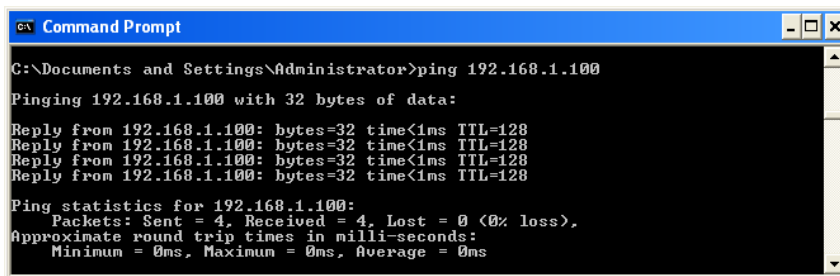
- iii) Type ipconfig. This will return the current PC's network adapter settings.



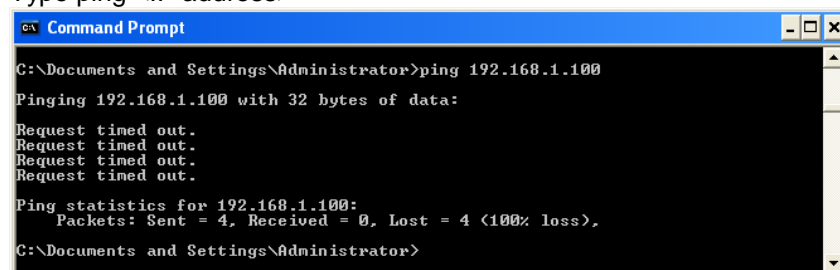
Ensure these settings are in the same subnet as the gateway. In this example, the PC would be able to contact the PC at default subnet (192.168.1.x), but not on 10.1.1.x.

- b) Check your network to ensure the MB40 has a unique IP address within the subnet. The best way to do this is via your router (if applicable). Otherwise you could power off the gateway, and then send a ping request to that IP address. If that address is already taken, you **will** get returned packets.

- i) Open the command prompt as above (on windows).

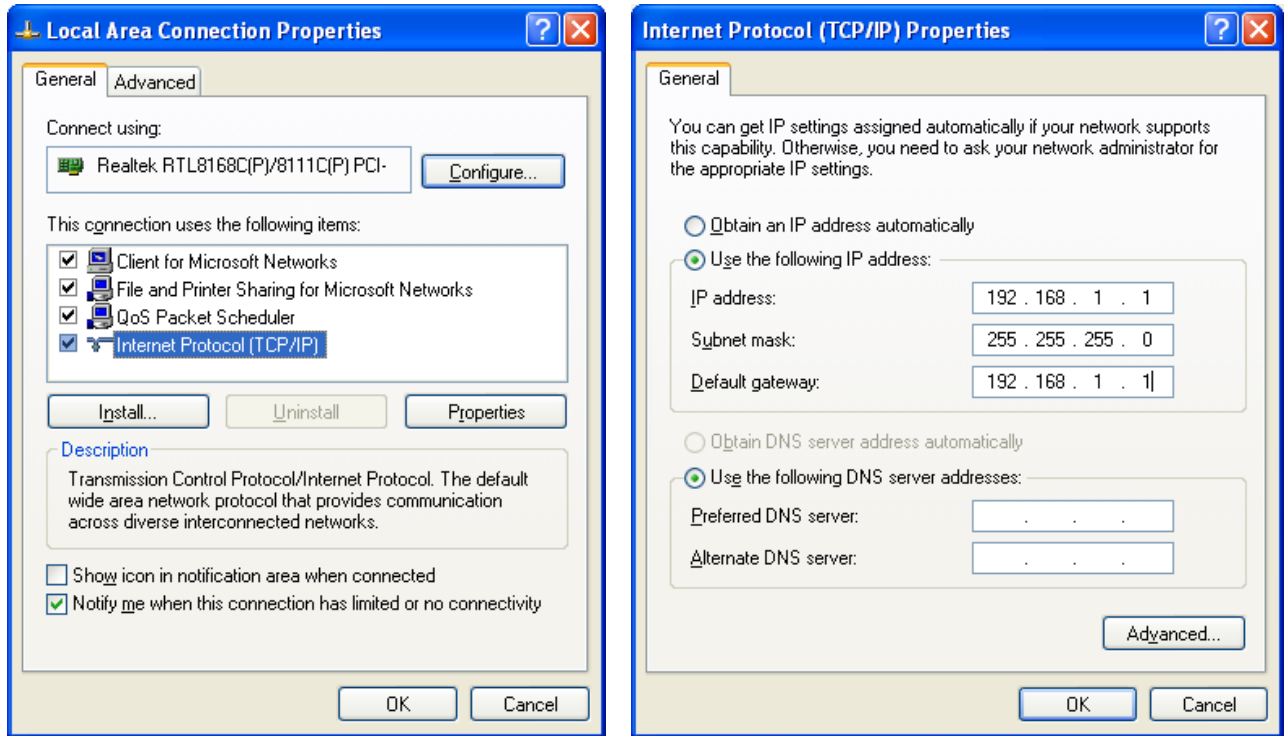


- ii) Type ping <IP address>



- iii) Make a direct connection to your PC using an Ethernet cable, and manually configure the PC to be on that subnet. On windows:

- (1) Set the TCP/IP settings of the gateway to default.
- (2) Open the Control Panel and go to network connections.
- (3) Right click on the LAN adapter and go to properties
- (4) Click on Internet Protocol (TCP/IP) and go to properties



- (5) Click on “use the following IP address” and set the values to:  
 IP Address: 192.168.1.1  
 Subnet Mask: 255.255.255.0  
 Default Gateway: 192.168.1.1
- (6) Use a ping request to 192.168.1.100. You should get returned packets.
- (7) Point your web browser to the IP address. A webpage should be displayed.

## Appendix A

### Complete Holding Register Listing

Holding Register Address 40,000+	No. of Registers	Type	Description
<b>1</b>	1	Time	Year in format YYYY
<b>2</b>	1	Time	Month and day in format MMDD
<b>3</b>	1	Time	Hour in format HH
<b>4</b>	1	Time	Minute and second in format MMSS
<b>5 to 59</b>	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
<b>60</b>	1	Status	Comms status for the R3 command. 0 = bad, 1 = good.
<b>61</b>	1	Time	Year in format YYYY
<b>62</b>	1	Time	Month and day in format MMDD
<b>63</b>	1	Time	Hour in format HH
<b>64</b>	1	Time	Minute and second in format MMSS
<b>65 to 119</b>	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
<b>120</b>	1	Status	Comms status for the MEM 1 LAST command. 0 = bad, 1 = good.
<b>121</b>	1	Time	Year in format YYYY
<b>122</b>	1	Time	Month and day in format MMDD
<b>123</b>	1	Time	Hour in format HH
<b>124</b>	1	Time	Minute and second in format MMSS
<b>125 to 179</b>	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
<b>180</b>	1	Status	Comms status for the MEM 2 LAST command. 0 = bad, 1 = good.
<b>181</b>	1	Time	Year in format YYYY
<b>182</b>	1	Time	Month and day in format MMDD
<b>183</b>	1	Time	Hour in format HH
<b>184</b>	1	Time	Minute and second in format MMSS
<b>185 to 239</b>	1	Data	Unpacked weather data. Up to 54 “pieces” of comma separated data is sequentially unpacked and placed into holding registers.
<b>240</b>	1	Status	Comms status for the MEM 3 LAST command. 0 = bad, 1 = good.
<b>242</b>	1	Product Code	Should read 144
<b>243</b>	1	Firmware Version	100 = 1.0.0 rev
<b>244</b>	1	Modbus	

		RTU address	
245	1	Modbus RTU baud rate	
246	1	Modbus RTU parity	0 = None 2 = Even 3 = Odd
247	1	Weather station polling period	default: 25 = 2.5 seconds
248	1	Year argument	Four digits: format YYYY
249	1	Month argument	Two digits: format MM. Padded with leading zeroes.
250	1	Day argument	Two digits: format DD. Padded with leading zeroes.
251	1	Commit Date to Weather Station	Write a 1 to send date command.
252	1	Hour argument	Two digits: format HH. Padded with leading zeroes.
253	1	Minute argument	Two digits: format MM. Padded with leading zeroes.
254	1	Second argument	Two digits: format SS. Padded with leading zeroes.
255	1	Commit Time to Weather Station	Write a 1 to send time command.
256	1	IP Config	1st octet IP Address
257	1	IP Config	2nd octet IP Address
258	1	IP Config	3rd octet IP Address
259	1	IP Config	4th octet IP Address
260	1	IP Config	1st octet Subnet Mask
261	1	IP Config	2nd octet Subnet Mask
262	1	IP Config	3rd octet Subnet Mask
263	1	IP Config	4th octet Subnet Mask
264	1	IP Config	1st octet Default Gateway
265	1	IP Config	2nd octet Default Gateway
266	1	IP Config	3rd octet Default Gateway
267	1	IP Config	4th octet Default Gateway
268	1	IP Config	Commit to Gateway (write a 1)
269	1	Unused	
270	1	Unused	